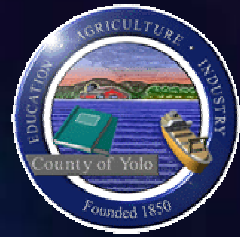
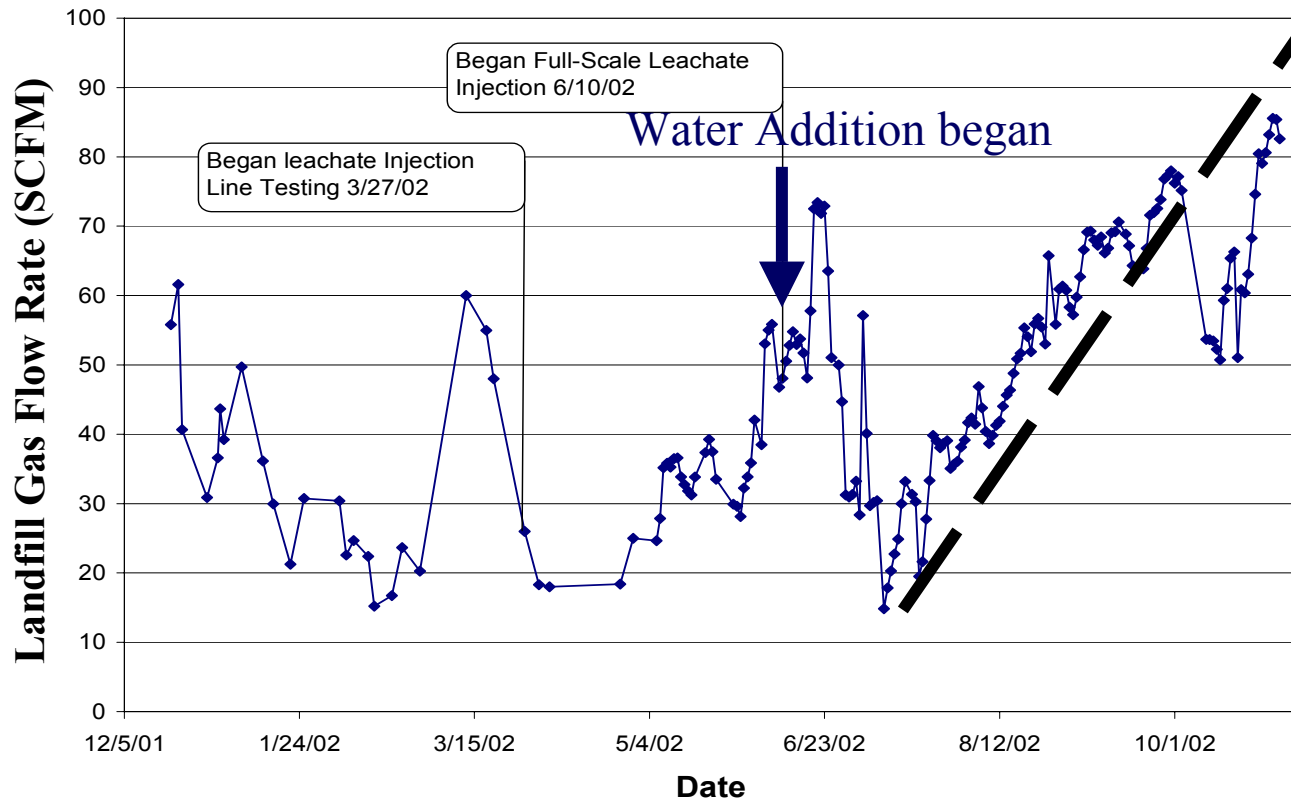


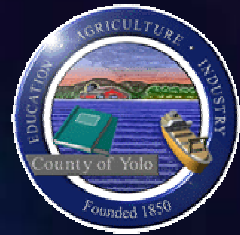
US EPA ARCHIVE DOCUMENT



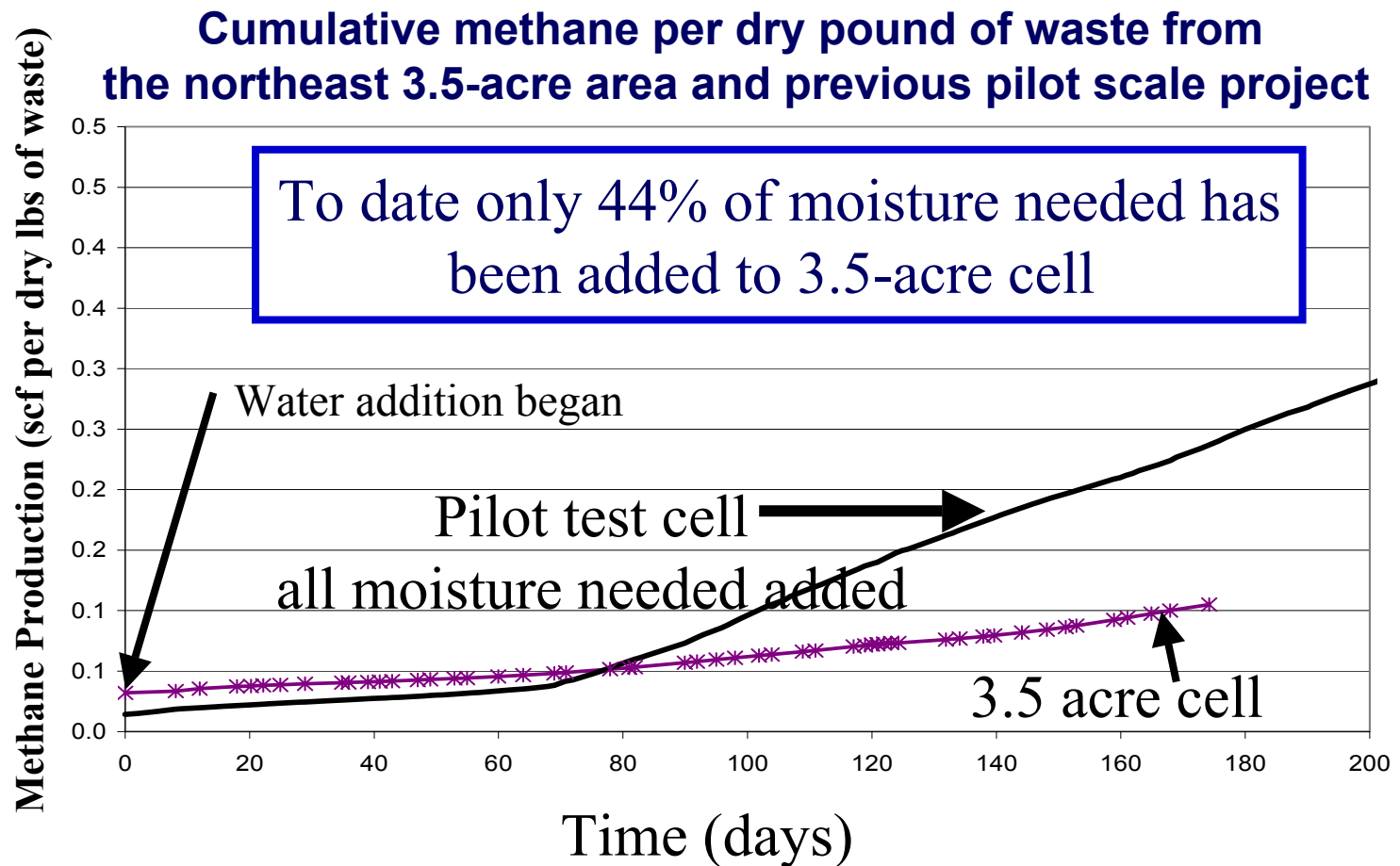
Full-Scale Project Results

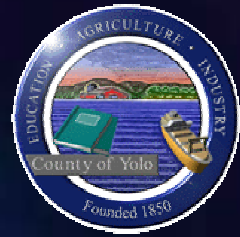
Landfill gas flow rate from main landfill gas header line for northeast 3.5-acre bioreactor





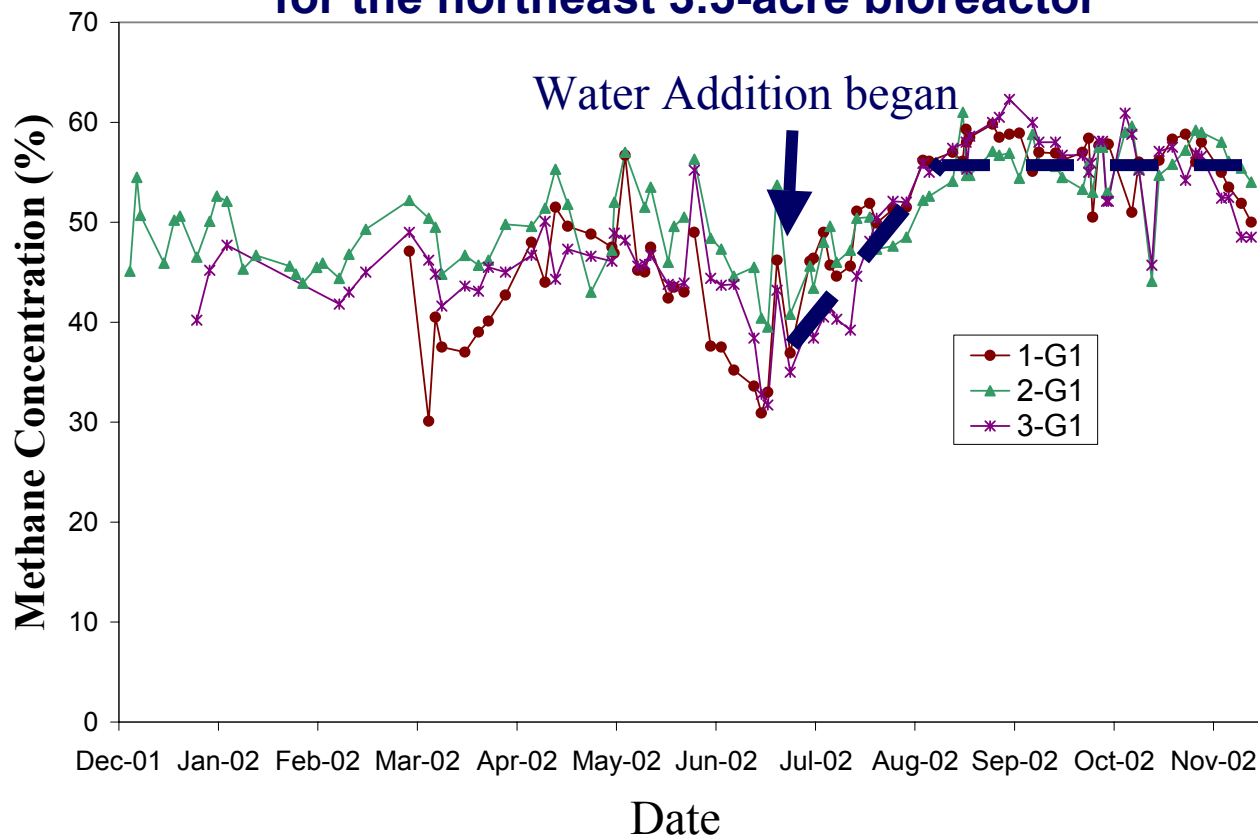
Full-scale Project Results

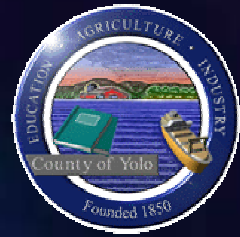




Full-scale Project Results

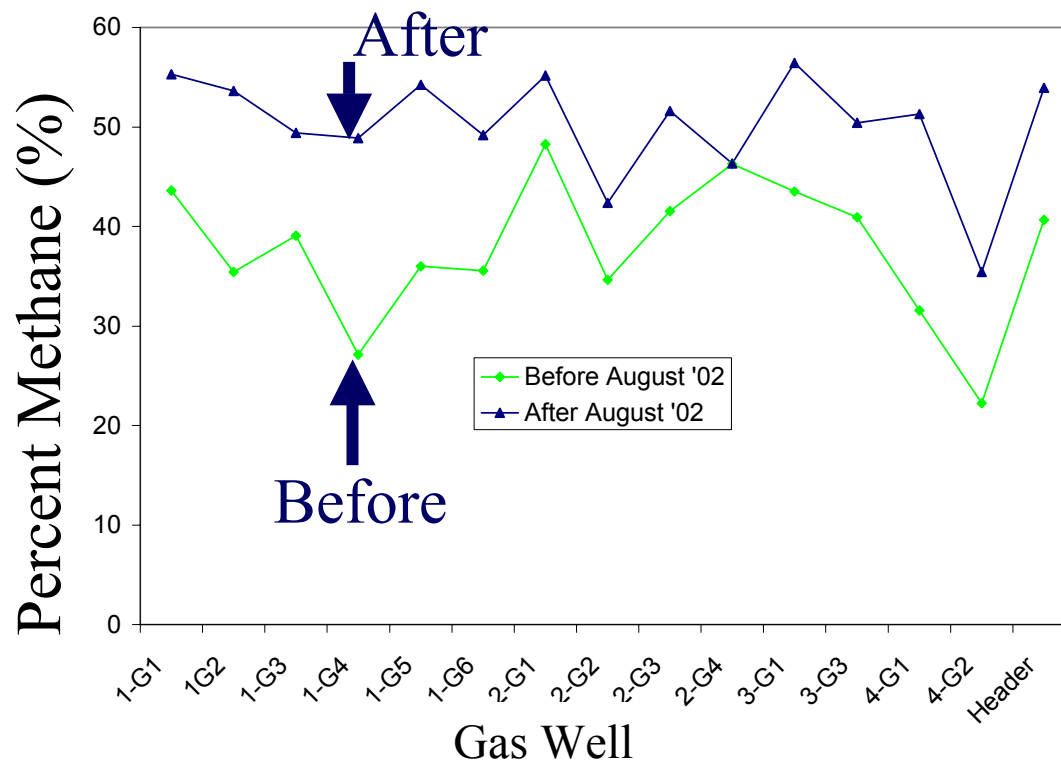
**Methane Concentration of three selected gas wells
for the northeast 3.5-acre bioreactor**

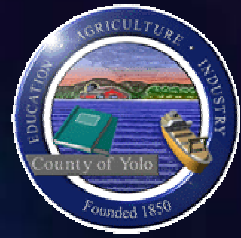




Full-scale Project Results

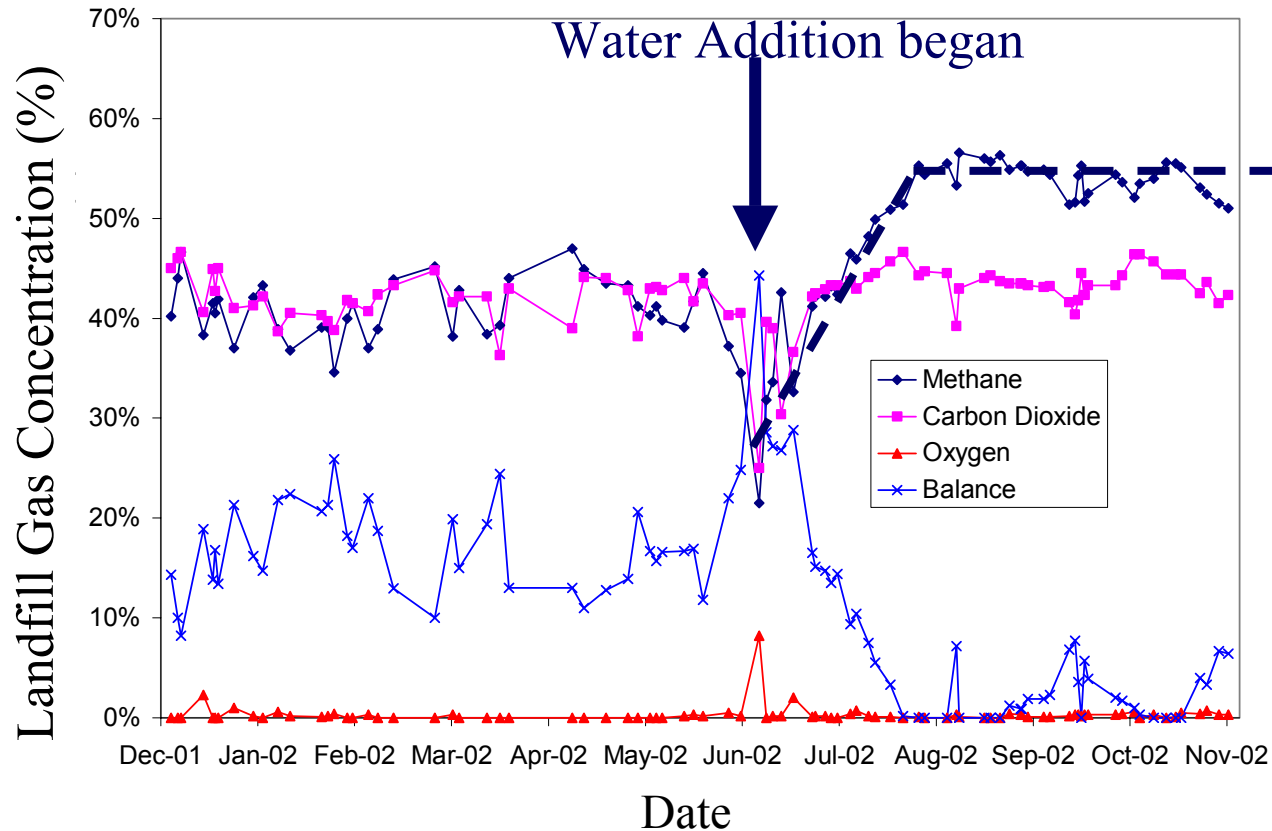
Average methane concentration of each individual gas wells before and after leachate addition (3.5-acre cell)

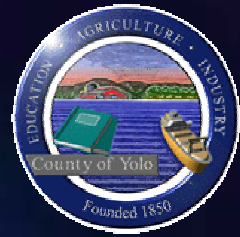




Full-scale Project Results

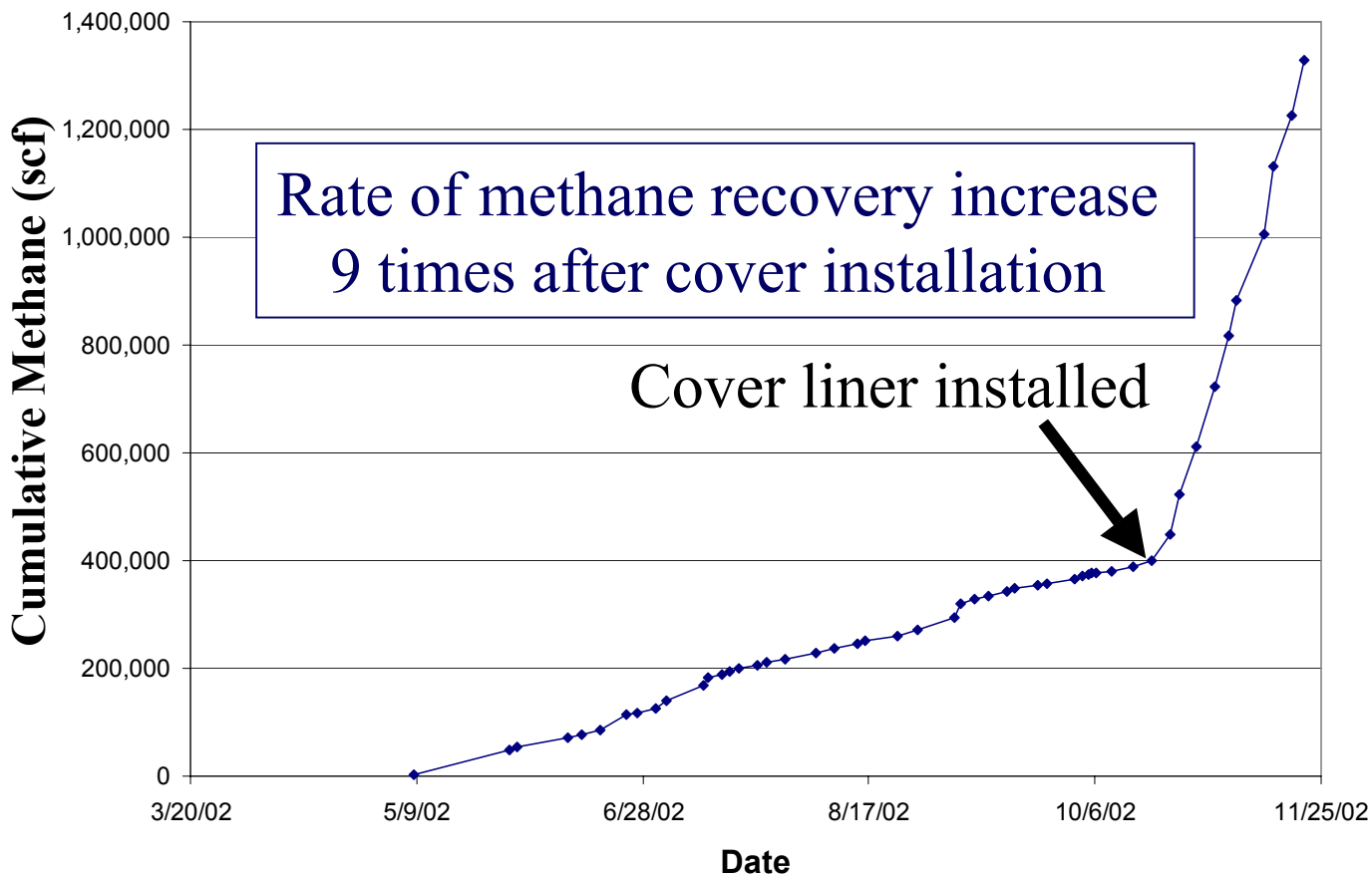
Landfill gas concentrations from gas header line for northeast 3.5-acre cell

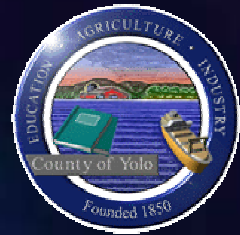




Full-scale Project Results

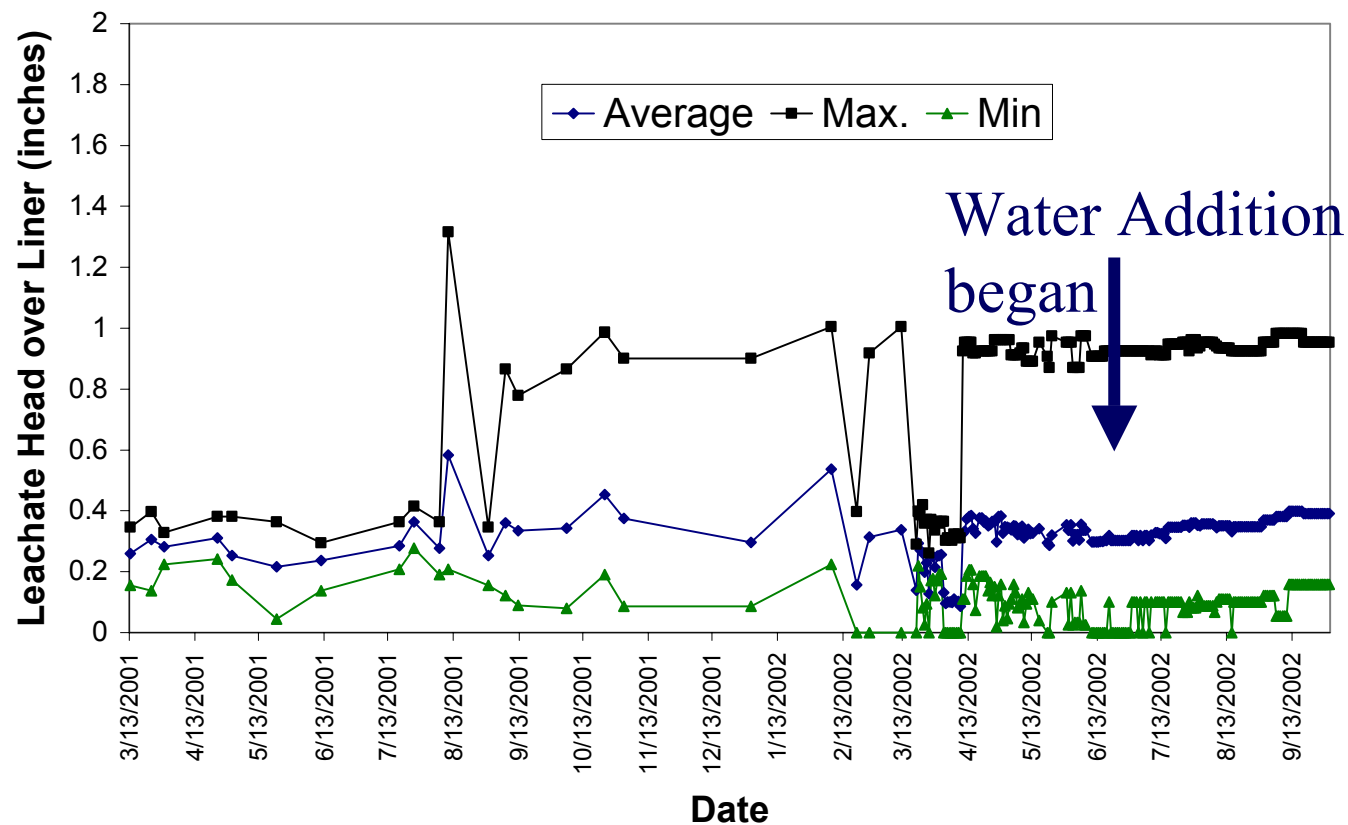
**Cumulative methane production from
the west 6-acre area**

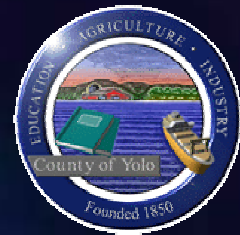




Full-scale Project Results

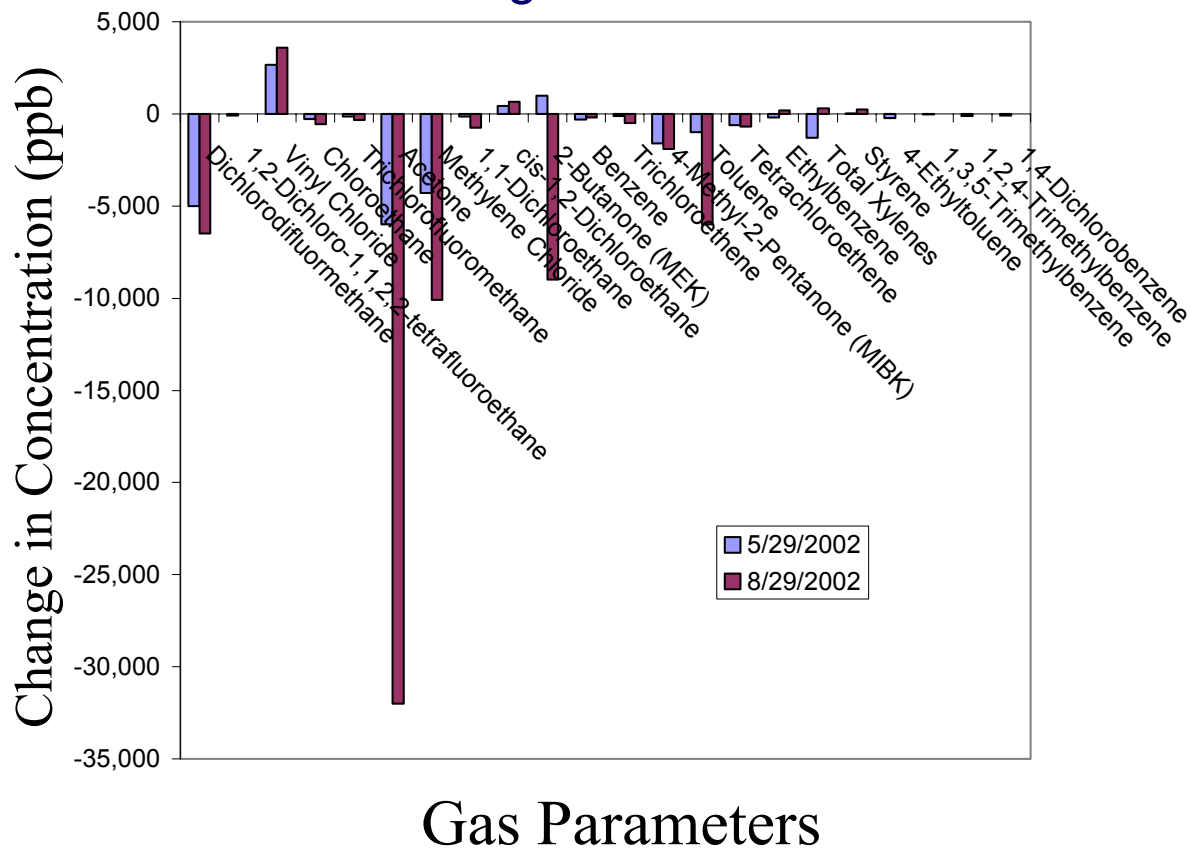
Leachate head over the liner for the full-scale bioreactor project



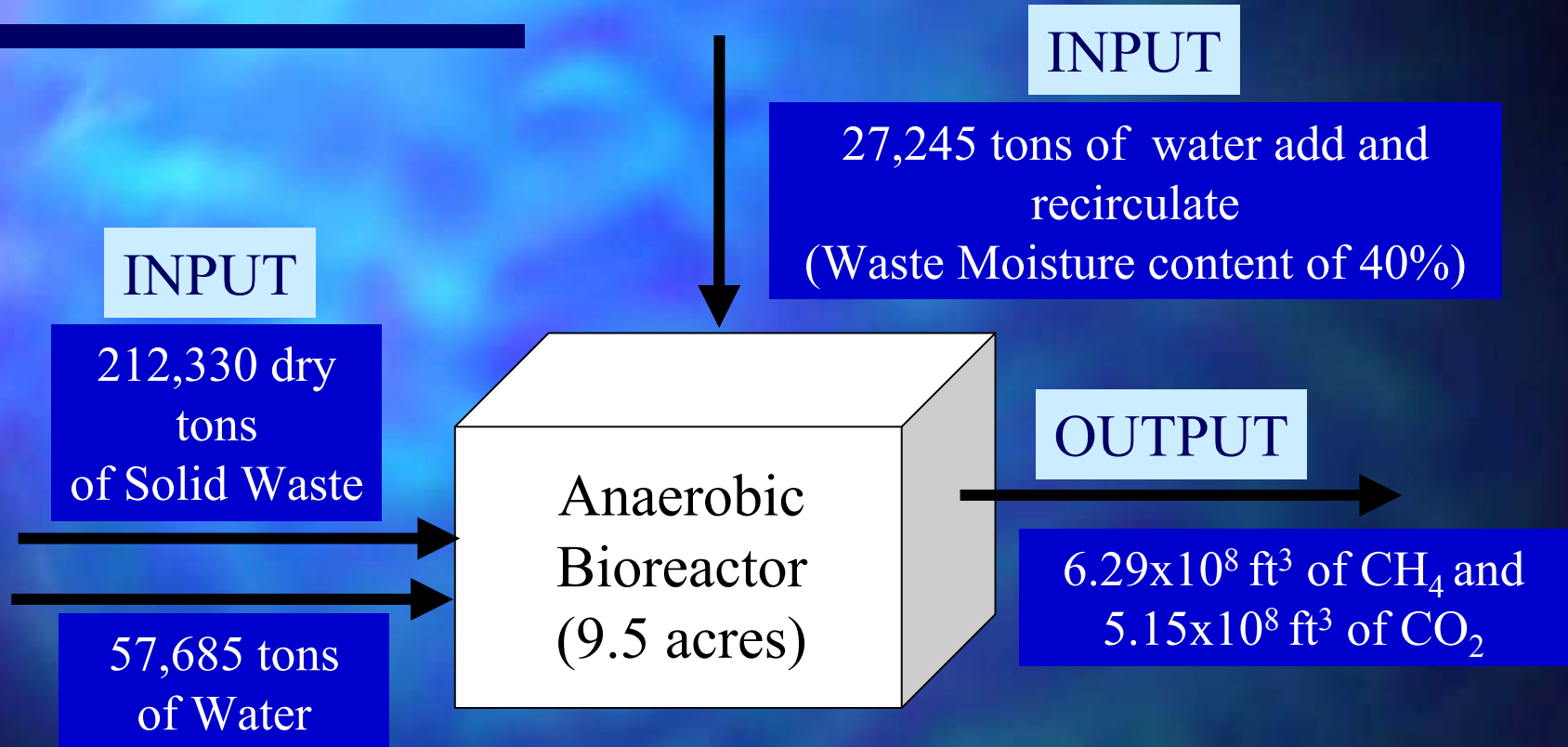


Full-Scale Project Results

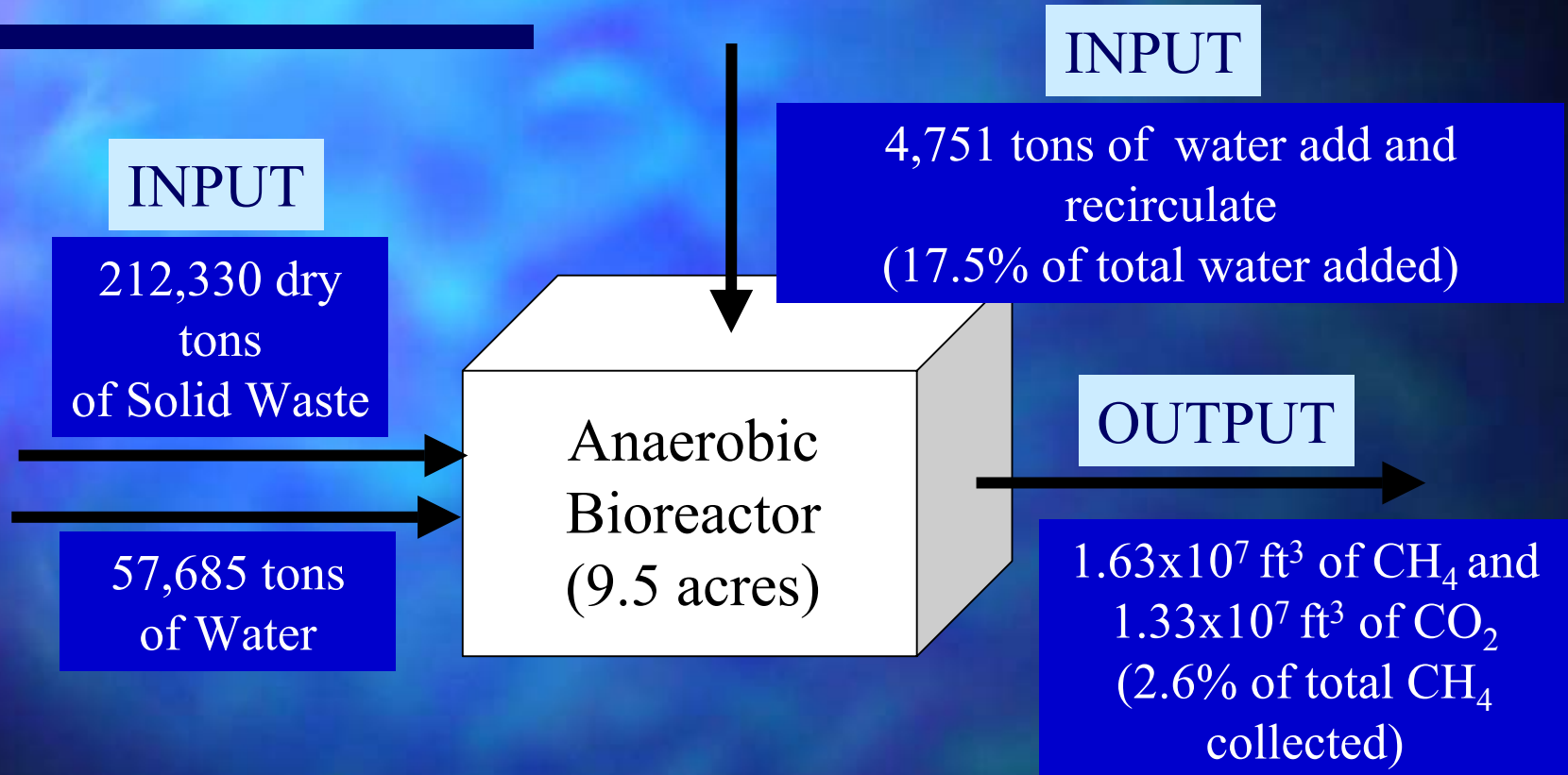
Reduction in landfill gas constituent concentration



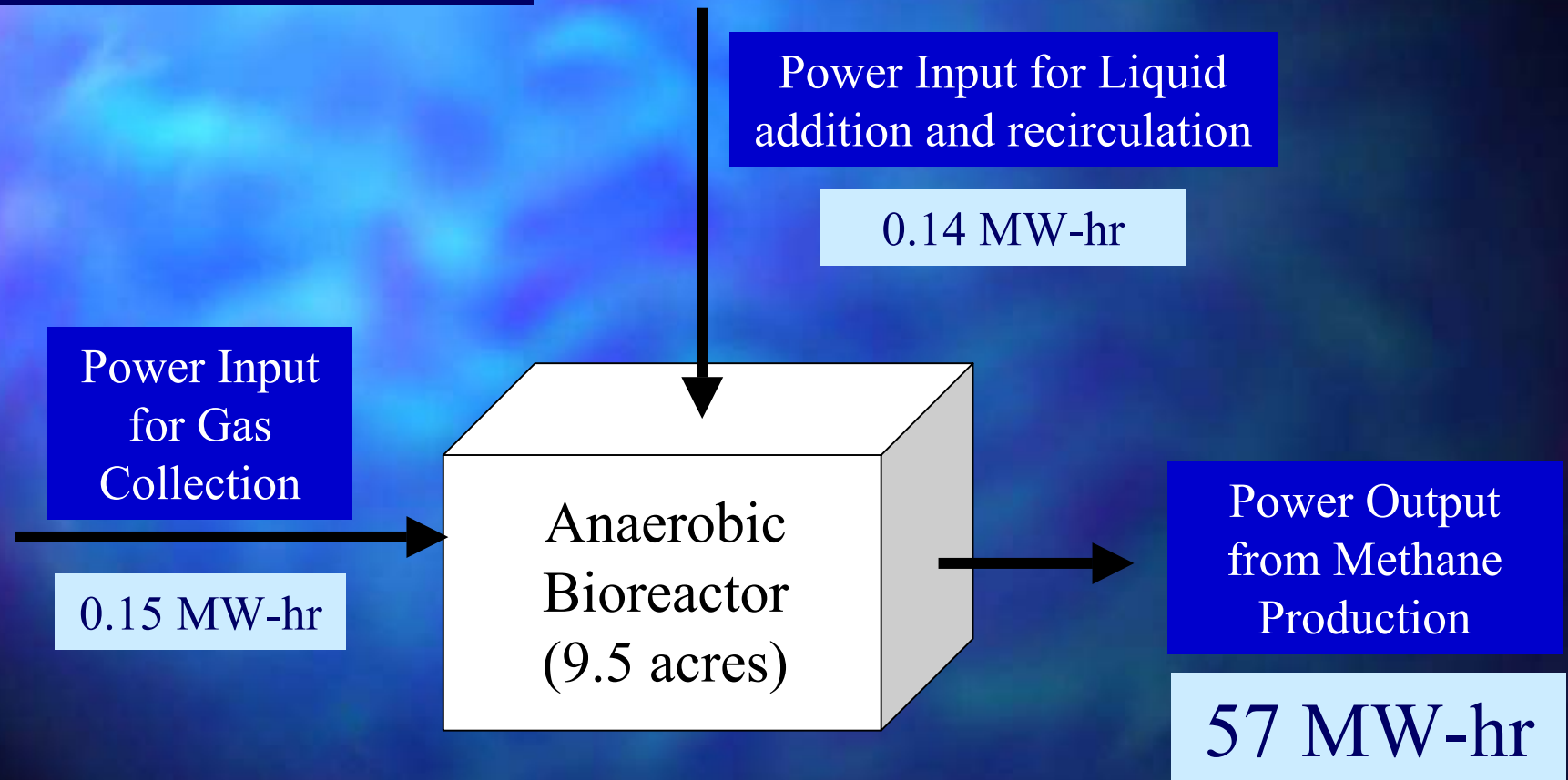
Total Mass Balance for Anaerobic Bioreactor



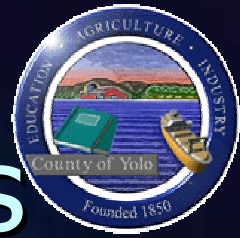
Current Mass Balance for Anaerobic Bioreactor



Total Energy Balance for Anaerobic Bioreactor

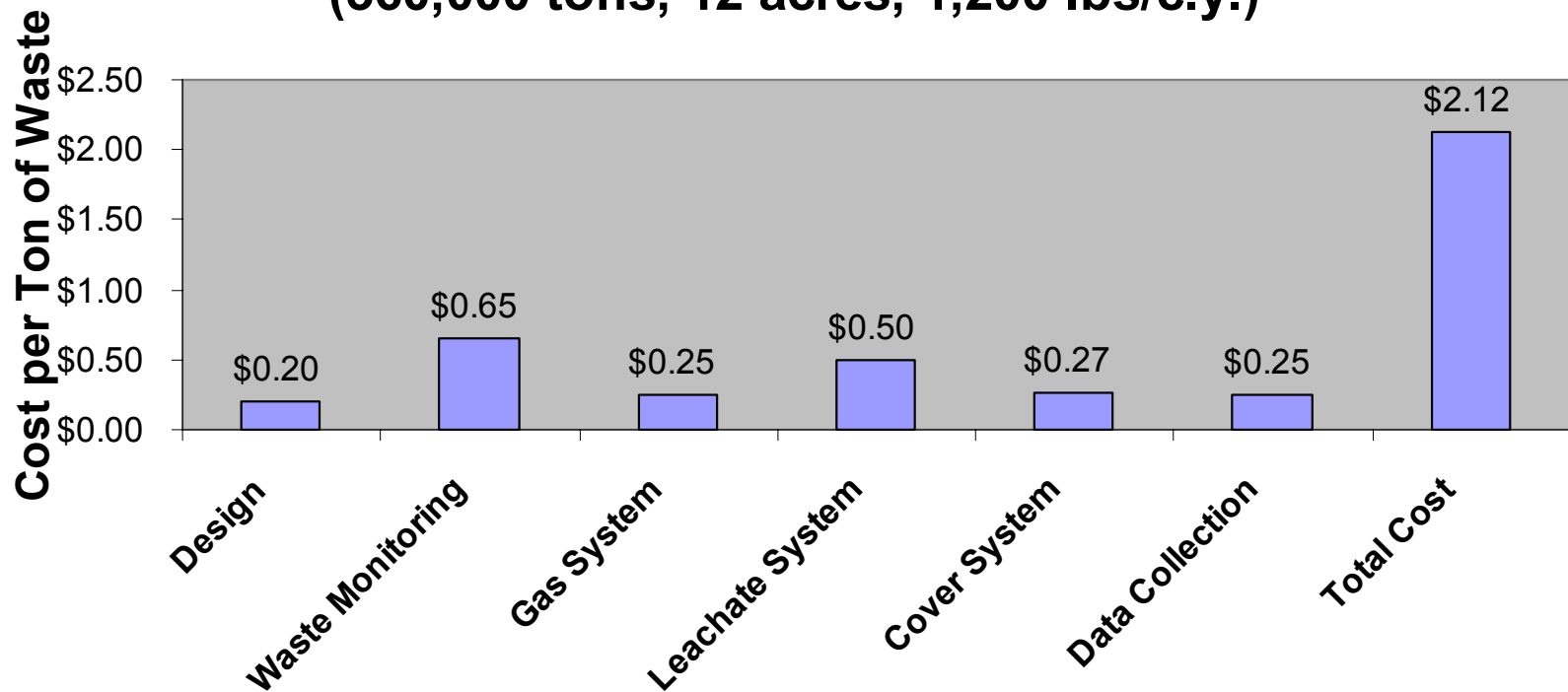


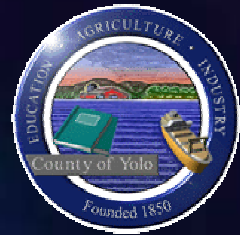
Parasitic Losses = 0.51% \sim < 1 %



Full-scale Project Economics

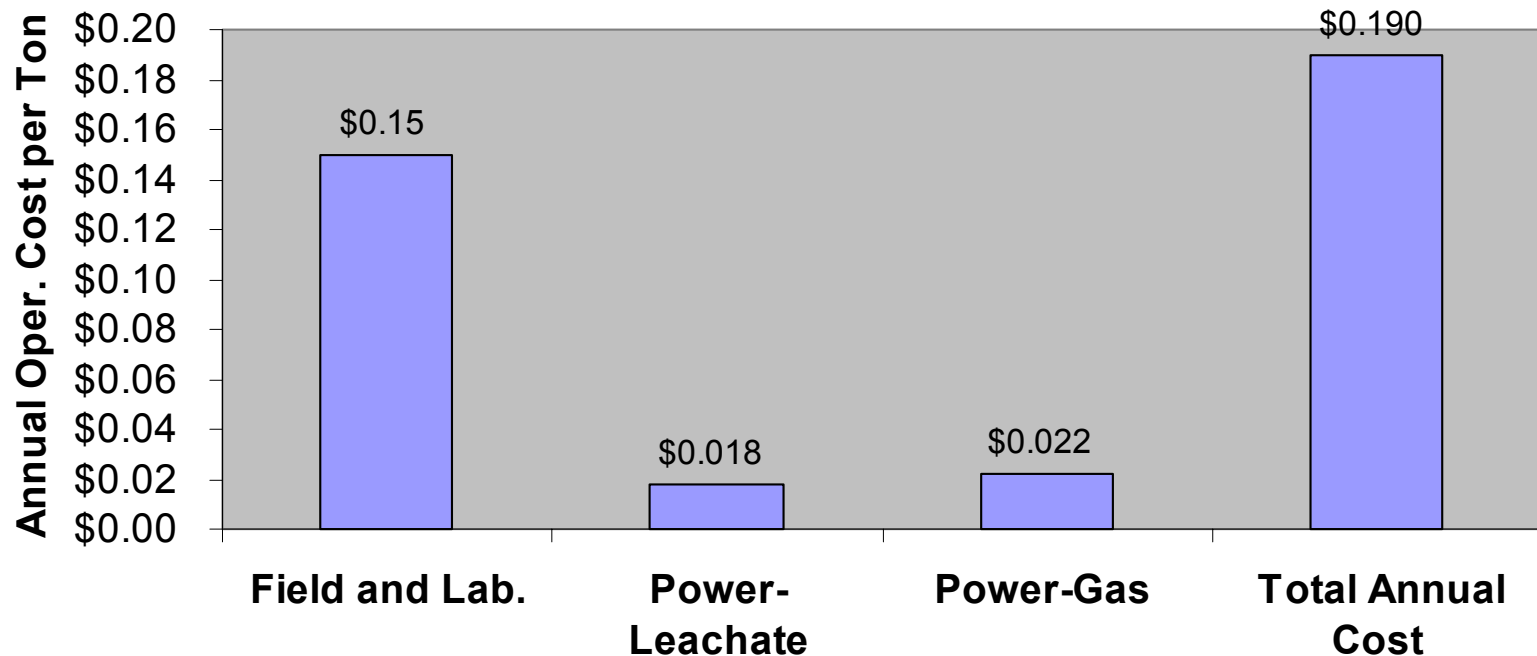
**Capital Cost per Ton of Waste
(360,000 tons, 12 acres, 1,200 lbs/c.y.)**

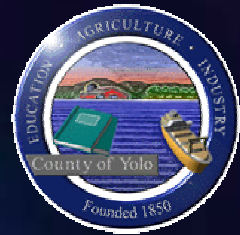




Full-scale Project Economics

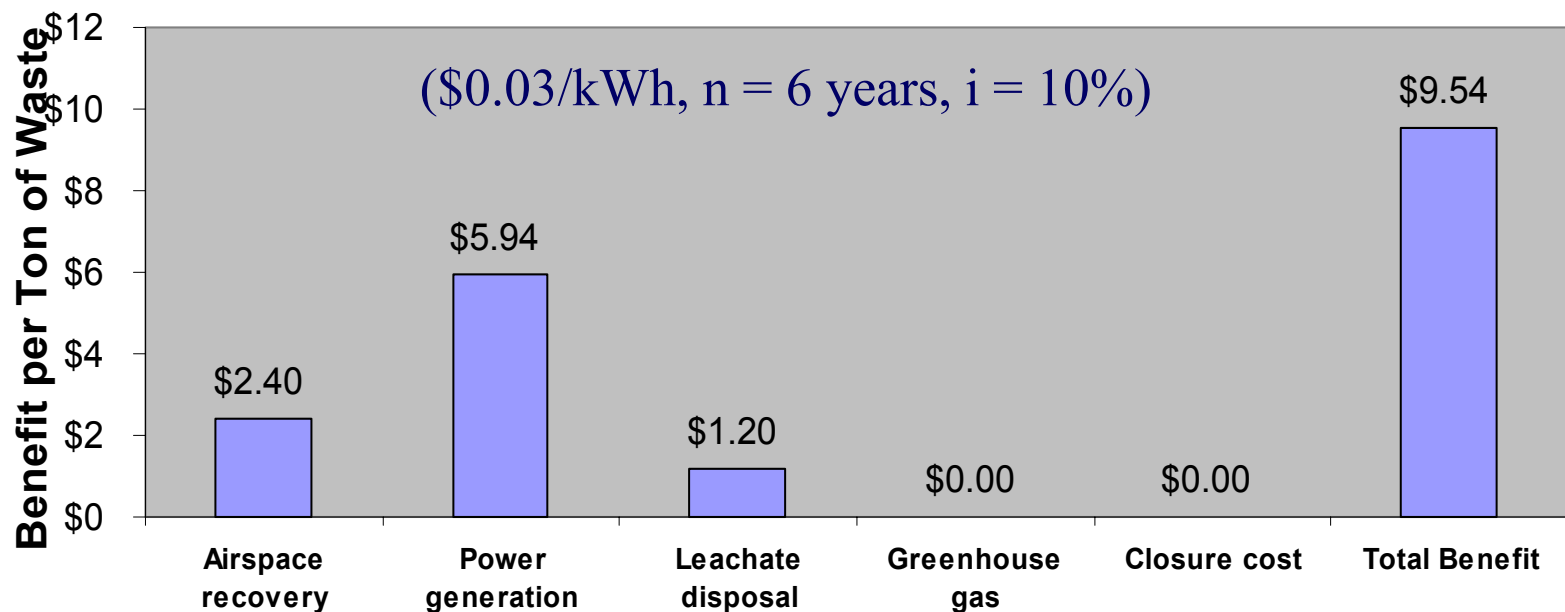
**Annual Operating Cost per Ton of Waste
(360,000 tons, 12 acres, 1,200 lbs/c.y.)**

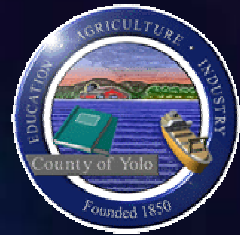




Full-scale Project Economics

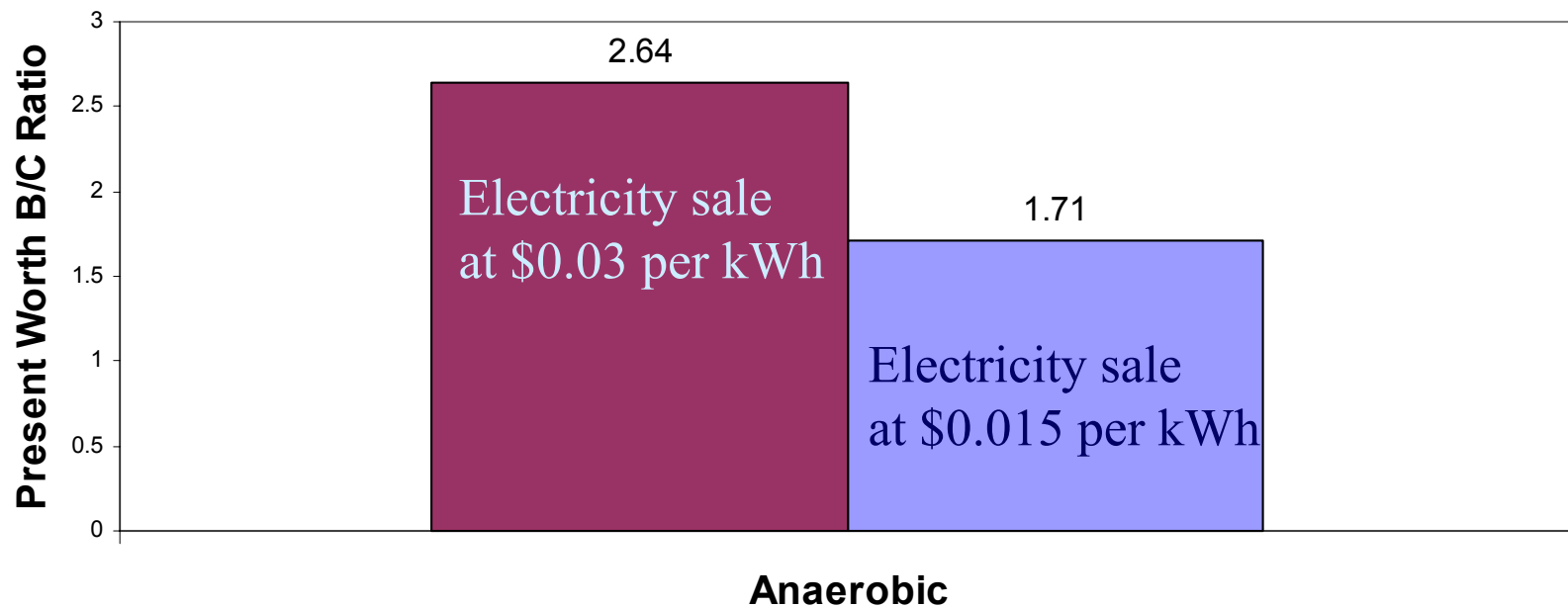
Total Benefit per Ton of Waste
(360,000 tons, 12 acres, 1,200 lbs/c.y.)

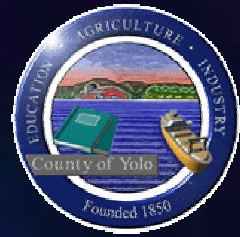




Full-scale Project Economics

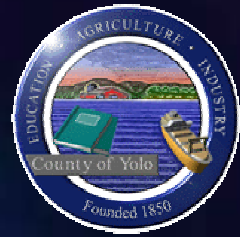
**Present Worth Benefit Cost Ratio
(360,000 tons, 12 acres, 1,200 lbs/c.y.)**





Design, Construction, and Operation Challenges

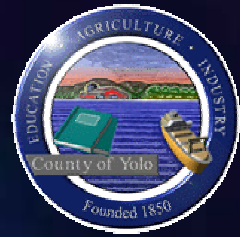
- Liner cap design and construction
- Installation of instrumentation after waste filling
- Securing installed liner and penetration of pipes through the cap
- Leachate injection system & precipitation of calcium carbonate
- HDPE Injection lines-drilling and installing fittings
- Pressurized (liquid) Leachate injection system-inspection for leaks



Conclusions

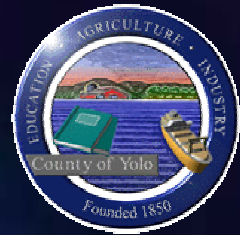
■ Bioreactors can:

- Be constructed with normal landfill equipments
- Be operated in a safe manner
- Be instrumented during waste filling phase
- Collect landfill gas under cover to reduce fugitive emissions via horizontal gas collection system
- Be operated to slowly inject leachate and prevent hydrostatic head build up over the base liner



Conclusions

- Bioreactors can:
 - Be operated to inject leachate horizontally to distribute moisture uniformly
 - Be designed to be operated by a SCADA system
 - Be designed Collect real-time field data for monitoring, control, and data collection
 - Be have a master database for data management and reporting
 - Be economical to construct and operate



THE END

QUESTIONS?

***Thank
You!***

